UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/720,752	11/25/2003	Emiel Jozef Melanie Eussen	081468-0306993	2765

909 7590 02/27/2007

PILLSBURY WINTHROP SHAW PITTMAN, LLP
P.O. BOX 10500
MCLEAN, VA 22102

EXAMINER	
TURNER, SAMUEL A	
ART UNIT	**PAPER NUMBER**
2877	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/27/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/720,752	EUSSEN ET AL.	
	Examiner	Art Unit	
	Samuel A. Turner	2877	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 February 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *25 November 2003* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 9 January 2007 has been entered.

Abstract

The abstract of the disclosure is objected to because the form and legal phraseology often used in patent claims must be avoided. Correction is required. See MPEP § 608.01(b).

Drawings

The drawings are objected to because figures 1, 2, 3a, 3c, and 3d must be labeled as prior art.

Figure 1 shows a photolithographic apparatus of the prior art, see figure 1 of den Boëf (6,384,899).

Figure 2 is a heterodyne interferometer of the prior art, see figure 2 of Phillips(4,311,390).

Figure 3a is a polarization interferometer of the prior art, see figure 1 of Wayne(4,784,490).

Figure 3c is a differential polarization interferometer of the prior art, see figure 1 of Tsai(5,191,391).

Figure 3d is also a differential polarization interferometer wherein the two measurement mirrors are both moving, see figure 3 of Tanimoto et al(5,151,749).

While applicant uses these prior art arrangements to explain the invention, the basic interferometer structures shown in figures 1, 2, 3a, 3c, and 3d are prior art.

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the a beam generator comprising a single beam-splitter block configured to generate a plurality of radiation beams and split the plurality of radiation beams into measuring and reference beams must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application.

Replacement Drawing Sheets

Drawing changes must be made by presenting replacement sheets which incorporate the desired changes and which comply with 37 CFR 1.84. An explanation of the changes made must be presented either in the drawing amendments section, or remarks, section of the amendment paper. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). A replacement sheet must include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of the amended drawing(s) must not be labeled as "amended." If the changes to the drawing figure(s) are not accepted by the examiner, applicant will be

notified of any required corrective action in the next Office action. No further drawing submission will be required, unless applicant is notified.

Identifying indicia, if provided, should include the title of the invention, inventor's name, and application number, or docket number (if any) if an application number has not been assigned to the application. If this information is provided, it must be placed on the front of each sheet and within the top margin.

Annotated Drawing Sheets

A marked-up copy of any amended drawing figure, including annotations indicating the changes made, may be submitted or required by the examiner. The annotated drawing sheet(s) must be clearly labeled as "Annotated Sheet" and must be presented in the amendment or remarks section that explains the change(s) to the drawings.

Timing of Corrections

Applicant is required to submit acceptable corrected drawings within the time period set in the Office action. See 37 CFR 1.85(a). Failure to take corrective action within the set period will result in ABANDONMENT of the application.

If corrected drawings are required in a Notice of Allowability (PTOL-37), the new drawings MUST be filed within the THREE MONTH shortened statutory period set for reply in the "Notice of Allowability." Extensions of time may NOT be obtained under the provisions of 37 CFR 1.136 for filing the corrected drawings after the mailing of a Notice of Allowability.

Claim Objections

Claim 21 is objected to under 37 CFR 1.75(c). The limitation "the beam-splitter block" now appears as "the beam-splitter, block", for which there is no antecedent basis.

Claim Rejections - 35 USC § 112, first paragraph

The following is a quotation of the first paragraph of 35 U.S.C. § 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and

exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 3-9, and 11-17 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claims 3 and 11 now include the limitations of: "a beam generator configured to generate a plurality of radiation beams, said beam generator comprising a single beam-splitter block having a beam splitting surface ··· wherein said beam splitter block is configured to split at least one first beam of said plurality of radiation beams into a first measuring beam and a first reference beam".

The specification does not provide for a beam generator comprising a single beam-splitter block which both generates a plurality of radiation beams and splits a first beam of said plurality of radiation beams into a first measuring beam and a first reference beam. Instead, as seen in applicant's figures 4a and 4b, two laser beams 50 and 51 are incident on a beam-splitting block 30 which then divides the beams into measurement and reference beams. Clearly, from figures 4a and 4b, the beam generator must be at least one laser and now cannot include the single beam-splitter block.

In claims 3 and 11 prior to amendment the beam generator used "comprising" and was not limited to a "single beam-splitter block". Thus the unamended limitation could be read as a beam generator that included both the source of the plurality of radiation beams and a beam-splitter block that splits the plurality of radiation beams into measuring and reference beams. As is now claimed, the single beam-splitter block must now both generate a plurality of radiation beams and split the plurality of radiation beams into measuring and reference beams, which is not found in the specification.

Claims 4-9, and 12-17 are dependent from claims 3 or 11 and therefor are also included in the rejection.

Claim Rejections - 35 USC § 112, second paragraph

The following is a quotation of the second paragraph of 35 U.S.C. § 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 3-24 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 3 and 11 as amended are confusing because the single beam-splitter block must both generate a plurality of radiation beams and then split the plurality of radiation beams. For purposes of any rejections, the limitation will be interpreted as a beam generator that generates a plurality of radiation beams

comprising a single beam-splitter block that splits the plurality of radiation beams. Claims 4-9, and 12-17 are dependent from claims 3 or 11 and therefor are also included in the rejection.

In claim 18 the phrase "wherein a position of at least one of said patterning device and said substrate is determined by an interferometer system" is indefinite because the phrase only suggest that the position is determined by an interferometer but does not specifically require the step to be performed. The phrase "which operates by" further confuses claim 18 because while the claim includes limitations to operation of the an interferometer, the steps required for operation of the interferometer appear to be suggested operations and not positively claimed required steps.

Claims 19-24 are dependent from claim 18 and therefor are also included in the rejection.

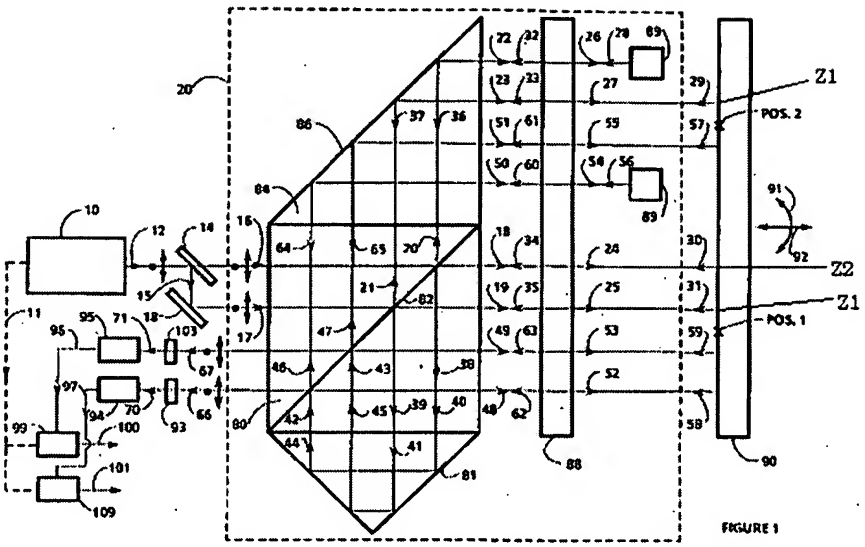
Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-4, and 9 are rejected under 35 U.S.C. § 102(b) as being clearly anticipated by Sommargren(4,859,066).



Note that Z1 and Z2 were added by the Examiner to help explain the measurement mirror areas.

With regard to claim 1, Sommargren teaches an interferometer system for measuring displacement, along at least two directions within a three dimensional system of coordinates, of an object in a plane substantially parallel to a two dimensional plane(Fig. 1), said interferometer system comprising:

a plane mirror interferometer system(column 3, line 43- column 4, line 56);

a differential plane mirror interferometer system(column 4, line 57- column 5, line 65);

a single beam splitter configured to split a radiation beam associated with said plane mirror interferometer system and a radiation beam associated with said differential plane mirror interferometer system into respective measuring beams and respective reference beams(Fig. 1, 80);

at least one measuring mirror fixedly connected to said object and comprising a plurality of measuring mirror areas(Fig. 1, 90); and

at least one reference mirror comprising one or more reference mirror areas that prevent said respective measuring beams and said respective reference beams from passing through said reference mirror(Fig. 1, 89).

As to claim 2/1, wherein said beam-splitter includes a transparent body having a beam-splitting surface(Fig. 1, 82) and a first reflector which is integrally connected to said transparent body and which has a reflective surface that extends substantially parallel to the beam splitting surface(Fig. 1, 86).

With regard to claim 3, Sommargren teaches an interferometer system for measuring displacement along at least two directions in an XYZ system of co-ordinates, of an object in a plane substantially parallel to an XY plane(column 2, line 2), said interferometer system comprising:

at least one measuring mirror fixedly connected to said object and comprising a plurality of measuring mirror areas(Fig. 1, 90);

at least one reference mirror comprising at least one reference mirror area(Fig. 1, 89);

a beam generator configured to generate a plurality of radiation beams(Fig. 1; 10,14,18), said beam generator comprising a single beam-splitter block(Fig. 1, 80) having a beam splitting surface(Fig. 1, 82);

a plurality of radiation-sensitive detectors configured to convert radiation beams reflected towards said detectors into electric measuring signals(Fig. 1; 84,85);

wherein said beam splitter block is configured to split at least one first beam of said plurality of radiation beams(Fig. 1, 16) into a first measuring beam(Fig. 1, 18) and a first reference beam(Fig. 1, 20),

said first reference beam only being reflected by one or more first reference mirrors located in a fixed position with respect to said beam-splitter block(Fig. 1, 89),

said first measuring beam being reflected by a first measuring mirror area of said plurality of measuring mirror areas(Fig. 1; 90,POS.1+Z2), and

wherein said beam splitting surface is configured to split at least one second beam of said plurality of radiation beams(Fig. 1, 17) into a second measuring beam(Fig. 1, 19) and a second reference beam(Fig. 1, 21),

said second measuring beam being reflected by a second measuring mirror area of said plurality of measuring mirror areas(Fig. 1; 90,POS.1+Z1), and

said second reference beam being reflected by a first reflector that is fixedly positioned with respect to said beam-splitter block(Fig. 1, 89) and by at least one third mirror area, which is movable with respect to said beam-splitter block(Fig. 1; 90,POS.2+Z1).

As to claim 4/3, wherein said at least one third mirror area comprises a third measuring mirror area fixed to said object(Fig. 1; 90,POS.2+Z1).

As to claim 9/3, wherein said beam-splitter block comprises a transparent body(Fig. 1, 80) having a beam-splitting surface(Fig. 1, 82) and a first reflector(Fig. 1, 84) which is integrally connected to said transparent body and which has a reflective surface that extends substantially parallel to the beam splitting surface(Fig. 1, 86).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. § 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. § 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR § 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. § 103(c) and potential 35 U.S.C. § 102(e), (f) or (g) prior art under 35 U.S.C. § 103(a).

Claims 5-8, and 10-24 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Sommargren(4,859,066) in view of Loopstra et al(6,020,964).

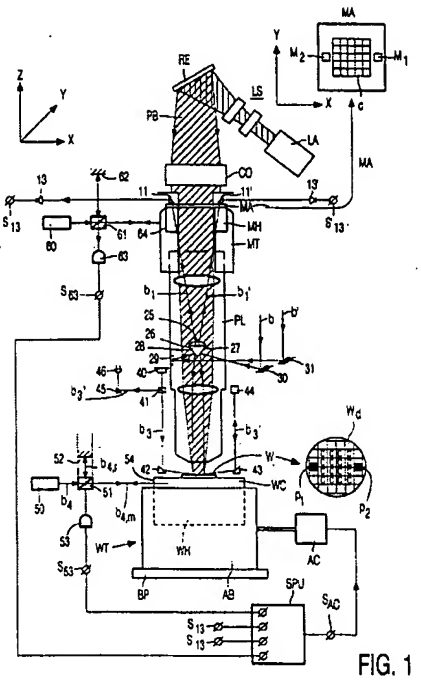


FIG. 1

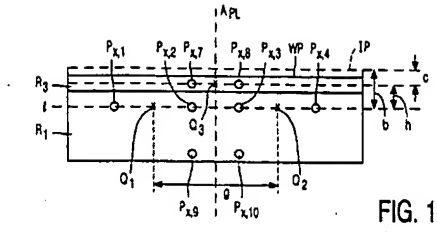


FIG. 14

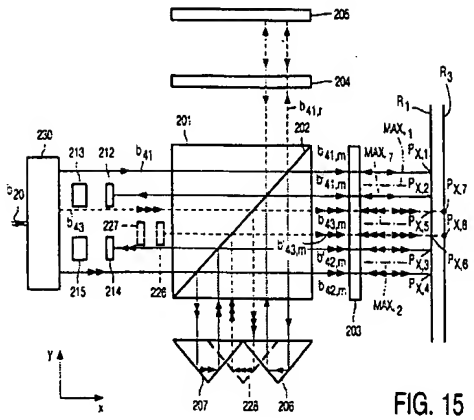


FIG. 15

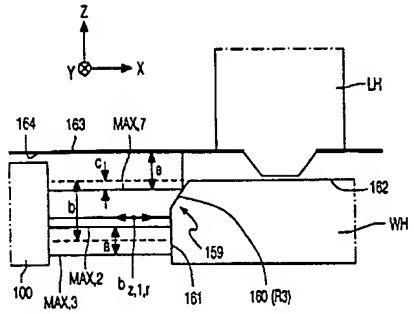


FIG. 5

With regard to claim 10, Sommargren teaches an interferometer system for measuring displacement of an XY stage(column 2, line 2), wherein said interferometer system comprises,

a plane mirror interferometer system(column 3, line 43- column 4, line 56);

a differential plane mirror interferometer system(column 4, line 57- column 5, line 65); and

a single beam-splitter block containing one beam splitter(Fig. 1, 80), at least one mirror(Fig. 1, 86), and at least one retro-reflector(Fig. 1, 81), such that said beam splitter block is configured to split a beam associated with said plane mirror interferometer system(Fig. 1, 16) and a beam associated with said differential plane mirror interferometer system(Fig. 1, 17) into respective measuring beams(Fig. 1; 18,19) and respective reference beams(Fig. 1; 20,21).

Sommargren fails to teach a lithographic apparatus comprising: an illumination system; a support structure; a substrate holder for holding a substrate; and a projection system.

With regard to claim 11, Sommargren teaches an interferometer system for measuring displacement of an XY-stage(column 2, line 2), wherein said interferometer system comprises,

at least one measuring mirror fixedly connected to said stage, said at least one measuring mirror comprising a plurality of measuring mirror areas(Fig. 1, 90);

at least one reference mirror comprising at least one reference mirror area(Fig. 1, 89);

a beam generator configured to generate a plurality of beams(Fig. 1; 10,14,18), said beam generator comprising a single beam-splitter block(Fig. 1, 80) having a beam splitting surface(Fig. 1, 82); and

a plurality of radiation-sensitive detectors configured to convert radiation beams reflected towards said detectors into electric measuring signals(Fig. 1; 94,95),

wherein said beam splitter block is configured to split at least one first beam of said plurality of radiation beams(Fig. 1, 16) into a first measuring beam(Fig. 1, 18) and a first reference beam(Fig. 1, 20),

said first reference beam only being reflected by one or more first reference mirrors located in a fixed position with respect to said beam-splitter block(Fig. 1, 89),

said first measuring beam being reflected by a first measuring mirror area of said plurality of measuring mirror areas(Fig. 1; 90,POS.1+Z2), and

wherein said beam splitting surface is configured to split at least one second beam of said plurality of radiation beams(Fig. 1, 17) into a second measuring beam(Fig. 1, 19) and a second reference beam(Fig. 1, 21),

said second measuring beam being reflected by a second measuring mirror area of said plurality of measuring mirror areas(Fig. 1; 90,POS.1+Z1), and

said second reference beam being reflected by a first reflector(Fig. 1, 89) that is fixedly positioned with respect to said beam-splitter block and by at least one third mirror area, which is movable with respect to said beam-splitter block(Fig. 1; 90,POS.2+Z1).

Sommargren fails to teach a lithographic apparatus comprising: an illumination system; a support structure; a substrate holder for holding a substrate; and a projection system.

As to claim 12/11, wherein said at least one third mirror area comprises a third measuring mirror area fixed to said object(Fig. 1; 90,POS.2+Z1).

As to claim 17/11, wherein said beam-splitter block comprises a transparent body(Fig. 1, 80) having a beam-splitting surface(Fig. 1, 82) and a first reflector(Fig. 1, 84) which is integrally connected to said transparent body and which has a reflective surface that extends substantially parallel to the beam splitting surface(Fig. 1, 86).

With regard to claim 18, Sommargren teaches determining the position of an XY-stage by an interferometer system(column 2, line 2), which operates by,

providing at least one measuring mirror fixedly connected to the XY-stage, said at least one measuring mirror comprising a plurality of measuring mirror areas(column 3, lines 43-44),

providing at least one reference mirror comprising one or more reference mirror areas that are configured to prevent beams from passing through said reference mirror(column 3, line 60),

providing a plurality of beams(column 3, lines 39-42),

providing a plurality of radiation-sensitive detectors(column 4, lines 38-40 and column 5, lines 46-49),

splitting at least a first beam of said plurality of beams, via a beam splitter block having a beam splitting surface, into a first measuring beam and a first reference beam, said first reference beam only being reflected by

one or more first reference mirrors located in a fixed position with respect to said beam-splitter block, said first measuring beam being reflected by a first measuring mirror area of said plurality of measuring mirror areas(column 3, line 43- column 4, line 26), and

splitting at least a second beam of said plurality of beams, via said beam splitting surface, into a second measuring beam and a second reference beam, said second measuring beam being reflected by a second measuring mirror area of said plurality of measuring mirror areas, and said second reference beam being reflected by a first reflector that is fixedly positioned with respect to said beam-splitter block and by at least one third mirror area, which is movable with respect to said beam-splitter block(column 4, line 56-column 5, line 35), and

converting beams which are reflected towards said detectors into electric measuring signals(column 4, lines 38-40 and column 5, lines 46-49).

Sommargren fails to teach a device manufacturing method comprising: providing a substrate; providing a beam of radiation; using patterning device to impart beam of radiation with a pattern in its cross-section; and projecting said patterned beam of radiation onto a target portion of the substrate.

As to claim 19/18, wherein said at least one third mirror area of said interferometer system comprises a third measuring mirror area fixed to said object(Fig. 1; 90,POS.2+Z1).

As to claim24/18, wherein said beam-splitter block comprises a transparent body(Fig. 1, 80) having a beam-splitting surface(Fig. 1, 82) and a first reflector(Fig. 1, 84) which is integrally connected to said transparent body and which has a reflective surface that extends substantially parallel to the beam splitting surface(Fig. 1, 86).

Loopstra et al teach a lithographic apparatus comprising(Fig. 1): an illumination system(column 8, lines 14-17); a support structure for supporting a patterning device(column 8, lines 2-5); a substrate holder for holding a substrate(column 8, lines 5-13); and a projection system(column 8, line 2).

With regard to claims 10, 11, and 18; it would have been obvious to one of ordinary skill in the art at the time the invention was made to include the Sommargren interferometer to measure the displacement of an XY-stage of a lithographic apparatus as shown in Loopstra.

The motivation for this modification is found in Sommargren which teaches that the figure 1 interferometer is used to measure XY-stage displacement in the semi-conductor industry(column 1, line 23- column 2, line 2).

Claims 12, 17, 19, and 24 are dependent from claims 11 or 18 and therefor are also included in the rejection.

As to claims 5/3, 13/11, and 20/18; Sommargren fails to teach wherein said at least one third mirror area comprises a second reflector fixed to said object and a second reference mirror area located in a fixed position with respect to said beam-

splitter block, wherein said second reflector is arranged to direct said second reference beam towards said second reference mirror area.

Loopstra et al teach a second reflector fixed to said object(Fig. 5, 160) and a second reference mirror(Fig. 5, 164) area located in a fixed position with respect to said beam-splitter block, wherein said second reflector is arranged to direct said second reference beam towards said second reference mirror area.

With regard to claims 5, 13, and 20; it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the interferometer of Sommargren by replacing the section of mirror from which beams 27 and 55 reflect(Fig. 1, POS.2±Z2) with an angled reflector and include a mirror on the projection lens in order to measure displacement of the XY-stage along a different angular axis.

The motivation for this modification is found in Loopstra which teaches that angular displacement along the Y-axis of a lithographic apparatus can be measured by an integrated interferometer(column 15, lines 16-40).

As to claims 6/3, 14/11, and 21/18; Sommargren fails to teach wherein at least one third mirror area comprises a fourth mirror area which is fixed to a second object, which is movable with respect to the beam-splitter block.

Loopstra et al teach a second reflector fixed to said object(Fig. 5, 160) and a fourth mirror area(Fig. 5, 164) which is fixed to a second object, which is movable with respect to the beam-splitter block.

With regard to claims 6, 14, and 21; it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the interferometer of Sommargren by replacing the section of mirror from which beams 27 and 55 reflect(Fig. 1, POS.2±Z2) with an angled reflector and include a mirror on the projection lens in order to measure displacement along a different axis.

The motivation for this modification is found in Loopstra which teaches that displacement along the Z-axis of a lithographic apparatus can be measured by an integrated interferometer(column 15, lines 8-15).

As to claims 7/3, 15/11, and 22/18; Sommargren fails to teach wherein said plurality of radiation beams comprises at least three first radiation beams occupying more than one plane and at least one second radiation beam in a position between two of said at least three first radiation beams.

As to claims 8/3, 16/11, and 23/18; Sommargren fails to teach wherein said plurality of radiation beams comprises at least three first radiation beams arranged to occupy a polygon volume and at least one second radiation beam in a position outside a polygon volume.

Loopstra et al teach generating a plurality of beams(fig's 10,12; b_{20}) which occupy more than one plane(fig. 14; $P_{x,1}$-$P_{x,10}$) and a second radiation beam(fig. 15, b_{43}) in a position between two of said at least three first radiation beams(fig. 14; $P_{x,7}$,$P_{x,8}$). Thus Loopstra et al can measure displacement along the X and Z axes

and angular displacement about the Y and z axes with a single integrated interferometer(column 19, line 26- column 24, line 23).

As shown in figure 1 of Sommargren, two degrees of freedom are measured; displacement along the X-axis and angular displacement about the Z-axis. Thus there are only two radiation beams 16 and 17 that form a line in the X-Y plane.

With regard to claims 7, 8, 15, 16, 22, and 23; it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Sommargren by generating a number of beams needed to measure displacement in four degrees of freedom, as suggested by Loopstra. One arrangement builds on the teaching of Sommargren which uses a single laser(Fig. 1, 10) a beam-splitter(Fig. 1, 10), and a reflector(Fig. 1, 10) to generated the first linear and differential interferometer beams.

By placing an additional beam-splitter/reflector in the path of the laser beam 12 oriented such that second linear interferometer beam 16' is generated and is reflected out of a plane formed by beams 16 and 17 into a second X-Y plane. Beam 16' would then follow the same beam paths as beam 16 except in a lower X-Y plane. The difference between the outputs of linear interferometer beams 16 and 16' is indicative of angular displacement about the Y-axis.

By placing an additional beam-splitter in the path of beam 15, oriented parallel to the beam-splitter 14, a second differential interferometer beam 17' is generated. The beam 17' would follow the same paths as beam 17 but the reference

beams would be incident on mirror 90 at points further from POS.2. This would provide a signal indicative of angular displacement about the Z-axis.

By replacing only the section of mirror from which beams 27 and 55 reflect(Fig. 1, POS.2±Z2) with an angled reflector and include a mirror on the projection lens a signal indicative of displacement along the Z-axis is generated. This would meet the limitations of claims 7, 15, and 22 of three first radiation beams occupying more than one plane(16,16',17) and a second radiation beam between two of the first radiation beams(16,17',17). This would also meet the limitations of claims 8, 16, and 23 of three first radiation beams arranged to occupy a polygon volume(16,16',17') and at least one second radiation beam in a position outside a polygon volume(17).

The motivation for this modification is found in Loopstra which teaches adding additional input beams to the integrated system to measure additional degrees of freedom.

Response to Arguments

Applicant's arguments filed 9 January 2007 have been fully considered but they are not persuasive. The arrangement of the laser(Fig. 1, 10) and the beam-splitter/reflector(Fig. 1;14,15) are used to generate the input beams of the linear and differential interferometers and are not part of the beam-splitter(Fig. 1, 80) that generates the measurement and reference beams(column 3, lines 25-42).

Relevant Prior Art

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Phillips(4,311,390), Wayne(4784490), Tanimoto et al(5,151,749), Tsai(5,191,391), and den Boef(6,384,899) have been cited as teachings of know basic interferometer configurations..

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Samuel A. Turner whose phone number is 571-272-2432.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory J. Toatley, Jr., can be reached on 571-272-2800 ext. 77.

The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Samuel A. Turner
Primary Examiner
Art Unit 2877